CRC-271

A006 783

ESTIMATING THE MARGINAL BALANCE OF PAYMENTS COST OF OVERSEAS HOMEPORTING

CENTER FOR NAVAL ANALYSES
1401 Wilson Boulevard
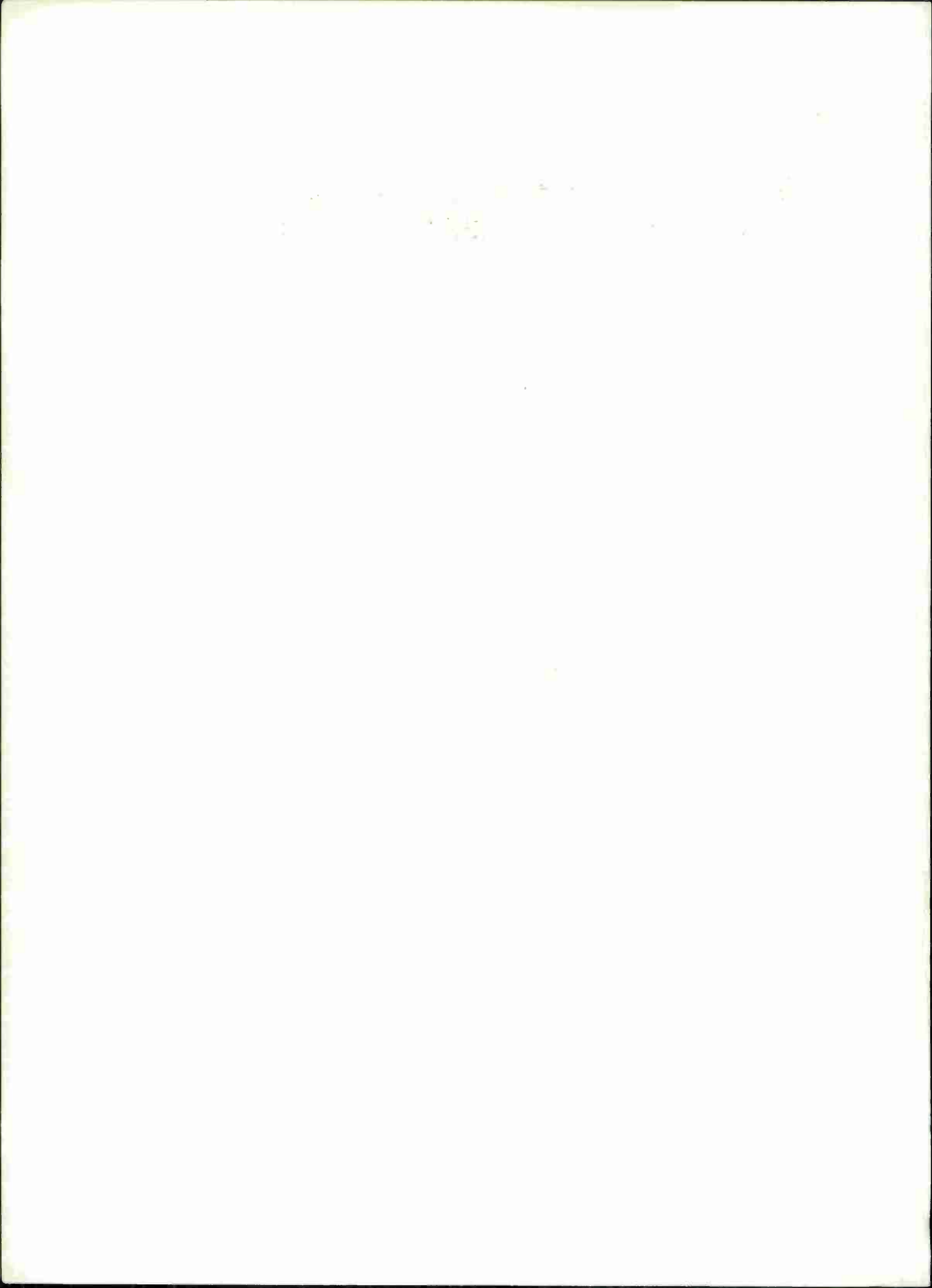Arlington, Virginia 22209
Institute of Naval Studies

December 1974

Pending approval for public release

Prepared for:

OFFICE OF NAVAL RESEARCH
Department of the Navy
Washington, D.C. 20350

OFFICE OF THE CHIEF OF NAVAL OPERATIONS (Op96)
Department of the Navy
Washington, D.C. 20380

02 027100.00

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER CRC 271	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER AD/A·006783
4. TITLE (and Subtitle) Estimating the Marginal Balance of Payments Cost of Overseas Homeporting		5. TYPE OF REPORT & PERIOD COVERED
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Peter H. Stoloff, John P. Aucella, LCdr., USN (over)		8. CONTRACT OR GRANT NUMBER(s) N00014-68-A-0091
9. PERFORMING ORGANIZATION NAME AND ADDRESS Center for Naval Analyses 1401 Wilson Boulevard Arlington, Virginia 22209		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Office of Naval Research Department of the Navy Washington, D.C. 20350		12. REPORT DATE December 1974
		13. NUMBER OF PAGES 19
14. MONITORING AGENCY NAME & ADDRESS(If different from Controlling Office) Office of the Chief of Naval Operations (Op96) Department of the Navy Washington, D.C. 20380		15. SECURITY CLASS. (of this report) Unclassified
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

The views expressed are those of the authors and do not necessarily represent the position of the Department of Defense.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

costs, homeporting, IBOP (International Balance of Payments), logistics support, maintenance, military facilities, ships, ship personnel

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A procedure for estimating the balance of payments cost of overseas homeporting is developed. Planning factors based on recent overseas homeporting experience are provided, in tabular form. By specifying certain characteristics of the overseas homeporting program, such as the ships to be homeported, the area, and the availability of base support, Navy planners can choose the appropriate planning factors to use in the estimation procedure. An application of the procedure using planning factors is shown.

DD FORM 1473 EO ~~JAN 73~~

PRICES SUBJECT TO CHANGE

[7]Contributors: Harold H. McKinley, Jr., LCdr., USN; Richard A. Kuzmack

23 January 1975

MEMORANDUM FOR DISTRIBUTION LIST

Subj: Center for Naval Analyses Research Contribution 271

Encl: (1)   CRC 271, "Estimating the Marginal Balance of
              Payments Cost of Overseas Homeporting," Peter
              H. Stoloff and LCdr. John P. Aucella,
              December 1974

1. Enclosure (1) is forwarded as a matter of possible interest.
The co-author is one of a select number of naval officers with
advanced degrees who, through a unique contract provision,
are assigned to CNA for a normal tour of shore duty to
participate in the Navy Study Program.

2. Research Contributions are distributed for their potential
value in other studies and analyses. They do not necessarily
represent the opinion of the Department of the Navy.

Herschel Kanter

HERSCHEL E. KANTER
Director
Institute of Naval Studies

Distribution List:
Reverse page

Subj: Center for Naval Analyses Research Contribution 271

DISTRIBUTION LIST

Department of the Navy

SNDL Part I:		SNDL Part II:	
21A	CINCPACFLT	A1	ASST SECNAV (I&L)
21A	CINCLANTFLT	A1	ASST SECNAV (FM)
21A	CINCUSNAVEUR	A2A	NAVCOMPT
22	COMSECONDFLT	A2A	OPA
22	COMTHIRDFLT	A4A	CHNAVMAT
22	COMSIXTHFLT	A5	CHNAVPERS
22	COMSEVENTHFLT	B1	ASST SECDEF (I&L)
24B	COMPHIBPAC	B1	ASST SECDEF (Comptroller)
24D	COMNAVSURFLANT	B2	SEC'Y JCS
24F	COMSERVPAC	B3	ICAF
28A	COMCARGRU 1	B3	AFSC
28A	COMCARGRU 2	FKA1C	NAVFACENGCOMHQ
28A	COMCARGRU 3	FKA1F	NAVSUPSYSCOMHQ
28A	COMCARGRU 4	FKA1G	NAVSEASYSCOMHQ
28A	COMCARGRU 5	FT69	USNA ANNA
28A	COMCARGRU 6	FT73	NAVPGSCOL
28A	COMCARGRU 7	FT75	NAVWARCOL
28C1	COMCRUDESGRU 1		
28C1	COMCRUDESGRU 2 DESDEVGRU		
28C1	COMCRUDESGRU 3		
28C1	COMCRUDESGRU 5		
28C1	COMCRUDESGRU 8		
28C1	COMCRUDESGRU 12		

OpNav:	Op-00K	Op-01
	Op-09	Op-10
	Op-09BH	Op-03
	Op-090	Op-30
	Op-90	Op-04
	Op-92	Op-06
	Op-96	

Other

Director, Defense Research and Engineering (OSD)
Director, Program Analysis & Evaluation (OSD)
Senior Naval Member, Weapon Systems Evaluation Group
Defense Logistics Studies Information Exchange (2)
Logistics Management Institute

TABLE OF CONTENTS

COMPONENTS OF MARGINAL BALANCE OF PAYMENTS COST

This paper focuses on the dollar outflow, resulting from homeporting ships overseas, that is over and above the dollars already being spent on foreign economies by ships routinely deployed to overseas areas from home ports in the United States. We refer to this increment as the marginal balance of payments cost.

Three kinds of spending by the Navy and its personnel were found to constitute almost all of the marginal international balance of payments (IBOP) costs to the overseas homeporting programs in Greece and Japan during fiscal year 1973. The types of spending are: (1) personal spending on the local economy by Navymen and their dependents while overseas, (2) ship's maintenance in foreign activities, and (3) overseas base support costs.

Personal Spending

The marginal personal spending IBOP cost is the difference between what overseas homeported personnel and their dependents living overseas spend on the local economy during the year and a prorated estimate of what CONUS deployed personnel would have spent on foreign economies during the same year.

The CONUS deployed personnel contribute to the IBOP cost by spending U.S. dollars for recreational activities and foreign goods purchased overseas. Overseas homeported personnel and their dependents purchase a wide range of goods, food, clothes, and spend additional funds for housing and other basic commodities.

Included in the IBOP cost for the CONUS deployed personnel is the cost of foreign goods imported by their dependents who remained in CONUS.

Ship's Maintenance

All ships which undergo maintenance and repairs in a foreign shipyard or in the Navy repair facilities which are manned primarily by foreign nationals contribute to the IBOP cost. A marginal IBOP cost exists because the overseas homeported ships expend more funds per ship-year for non-scheduled repairs in the foreign activities than the CONUS deployed ships and planned maintenance is scheduled for overseas homeported ships in the foreign activities whereas CONUS deployed ships return to the United States for such maintenance.

Non-scheduled maintenance includes restricted availabilities (RA) that require the induction of a ship into an industrial activity and technical availabilities (TA) where certain equipment is submitted to the shipyard for emergency repairs. Planned maintenance includes (1) overhauls, (2) selected restricted availabilities (SRA) that are scheduled for aircraft carriers, to provide concentrated repair efforts necessary for these ships to meet their strenuous operating commitments, and (3) planned RA periods which are scheduled to modify specific equipment under the Fleet Modernization Program or for other necessary maintenance if overhauls are deferred for financial reasons.

The IBOP cost for overseas homeported ships undergoing overhauls, SRA, and planned RA periods is all incremental to overseas homeporting; whereas the marginal IBOP cost for non-scheduled maintenance per ship-year is the difference in IBOP expenditures between the overseas homeported ships and the CONUS ships that would have been deployed during the same time

period. The marginal IBOP cost for ship's maintenance is the sum of non-scheduled and planned maintenance costs.

Base Support

An IBOP cost for base support of overseas homeported ships is incurred because facilities such as piers, commissaries, exchanges, landing fields and schools have to be built or rented, or existing facilities often have to be modified. The magnitude of the marginal IBOP costs will depend on the presence of existing facilities in the homeporting area. In some instances, the facilities provide services not only to the homeported units and their personnel but to CONUS deployed units and other personnel who are ashore to support the entire fleet. Our procedure estimates what portion of the IBOP costs of the shore facilities is associated with overseas homeporting.

Base support costs are classed as recurring and one-time costs. Recurring costs include leases and annual operating costs for utilities, housing, and foreign labor. One-time costs include expenditures incurred for construction of facilities.

The marginal IBOP cost for base support is the sum of the recurring and one-time costs.

Total Marginal IBOP Cost

Table 1 summarizes the three kinds of spending that contribute to the additional IBOP debit resulting from overseas homeporting programs.

TABLE 1

MARGINAL IBOP COSTS ASSOCIATED
WITH OVERSEAS HOMEPORTING

Personal spending	
Overseas homeported personnel	(+)
CONUS deployed personnel	(−)
Subtotal	
Ship's maintenance	
Non-scheduled repairs	
Overseas homeported ships	(+)
CONUS deployed ships	(−)
Planned maintenance	(+)
Subtotal	
Base support	
Recurring costs	(+)
One-time costs	(+)
Subtotal	

Total marginal IBOP = Marginal difference in personal spending +
marginal difference in non-scheduled repair costs +
planned maintenance costs + base support costs

-2-

PROCEDURE FOR ESTIMATING BALANCE OF PAYMENTS COSTS
OF OVERSEAS HOMEPORTING

The following paragraphs discuss the development and application of the procedure for estimating marginal IBOP costs due to personal spending, ship's maintenance and base support. Relationships uncovered in historical data describing IBOP costs in Greece and Japan are assumed to be applicable to other potential overseas homeporting areas. The assumptions which are made in order to estimate the balance of payments cost from the historical data from Greece and Japan also have to be made when estimating marginal costs for other areas. In addition, the following assumptions are necessary: (1) personal spending and ships' maintenance cost estimates for overseas homeporting in Greece and Japan are representative of such spending in all other Mediterranean and Western Pacific overseas homeports, respectively; and (2) base support costs are proportional to the number of men in the overseas homeport.

PERSONAL SPENDING

Overseas Homeported Personnel

Either of two closely related measures obtained from the historical data can be used as the basis for estimating the IBOP cost of personal spending by overseas-homeported personnel in future overseas homeports: (1) total personal spending overseas (TPS)·or (2) the portion of total personal spending that contributes to the IBOP cost (ITPS). Where no U.S. government sponsored facilities, such as housing, commissaries and exchanges, will be available in the overseas homeport, all personal spending overseas should contribute to the IBOP cost.[1] Since new overseas homeports may not have these facilities, we will use TPS for estimating IBOP costs.

To predict TPS we will use the model shown in equation (1). This linear estimation procedure will predict future IBOP when inflation and pay scale changes are expected if we assume that spending habits are stable in proportion to pay and allowances over time. In the model, personal spending for each overseas homeported individual is related to his (1) base pay; (2) dependency status (whether or not he is accompanied by dependents); (3) type of command (whether he is assigned to a sea or shore command); (4) type of housing (whether or not he is living in Navy housing; and (5) area of homeporting (Mediterranean or Western Pacific).

$$\widetilde{Y}_{TPS} = b_0 + b_1 Pay + b_2 Acc + b_3 Cmd + b_4 Housing + b_5 Area \qquad (1)$$

where $\widetilde{Y}_{TPS}$ = monthly IBOP estimate of total personal spending by a given individual

b_0 = regression constant

b_1 = regression weight for pay and allowances

Pay = base pay for men in paygrade i

b_2 = regression weight indicating unit IBOP cost for accompanied status

Acc = 0 if unaccompanied
1 if accompanied

b_3 = regression weight indicating unit IBOP cost for command status

---

[1] We assume that the same amount of money spent in the U.S. government sponsored facilities would be spent on the local economy if these facilities were not available.

Cmd = 0 if assigned to a ship
      1 if assigned ashore

b_4 = regression weight indicating unit IBOP cost for those living in Navy housing

Housing = 0 if not living in Navy housing
          1 if living in Navy housing

b_5 = regression weight indicating unit IBOP cost for homeporting area

Area = 0 for Mediterranean area
       1 for Western Pacific

It should be noted that no interactive terms, e.g., accompanied status within paygrade, are included in equation (1). This reflects the implicit assumption that, on the average, personal spending for those accompanied is proportional to their pay. This assumption was necessary because estimates of the numbers of accompanied personnel by paygrade cannot be specified by Navy planners for future years.

The regression weights were estimated from 1005 usable responses to a personal expenditure survey administered to overseas homeported personnel in Greece and Japan in FY 1973. The results of the analysis are shown in table 2.

TABLE 2

REGRESSION ANALYSIS OF TOTAL
PERSONAL SPENDING

Multiple R = .74
Standard error $(Y \cdot X)$ = 171

Variable	b	t	Partial r	Elast.
Pay	.48	21	.56	.60
Accompanied	196	15	.47	.21
Command type	38	2.8	.09	.02
Housing	−124	6.6	.21	−.04
Area	−7	.6	.02	0
(Constant)	106			

To the extent that ITPS is a constant proportion of TPS, i.e., the two measures are highly correlated, we can adjust the values of TPS predicted from the regression analysis ($\widetilde{TPS}$) to produce IBOP cost estimates for options which also include U.S. government sponsored facilities. This is accomplished by multiplying $\widetilde{TPS}$ by the constant proportion, f, i.e., $\widetilde{TPS} \times f = \widetilde{ITPS}$.

Table 3 shows the correlations (again from Greece and Japan) between the independent variables and TPS and the IBOP cost. The independent variables tend to correlate in a similar manner with TPS and the IBOP cost. TPS and IBOP cost correlate at .93. This suggests that the IBOP cost tends to be a relatively constant proportion of TPS, and that TPS could be used for estimating IBOP costs in overseas homeports with or without facilities.

When there are U.S. facilities where goods and services may be obtained, $\widetilde{Y}_{TPS}$ will overestimate the personal spending IBOP cost. To account for the possibility that these facilities will be available, we multiply $\widetilde{Y}_{TPS}$ by the proportion of TPS that we observed in the historical data, .69,

which sets a lower bound on the estimate for an overseas homeporting option that includes facilities.[1]

TABLE 3

SIMPLE CORRELATIONS AMONG VARIABLES

| Independent variable | Simple correlations[a] | | | | | |
| | Greece | | Japan | | Combined | |
	IBOP	TPS[b]	IBOP	TPS	IBOP	TPS
Accompanied	.48	.56	.33	.49	.40	.53
Command type	.34	.41	.16	.30	.24	.35
Pay	.67	.65	.50	.65	.57	.65
Housing	--	--	0	.26	-.06	.13
Area[c]	--	--	--	--	-.19	.17
$r_{IBOP,TPS}$	.95		.91		.93	
IBOP ÷ TPS	.69		.68		.69	
N	356		649		1005	

[a]Zero order Pearson product moment correlation coefficients.
[b]Total personal spending (overseas).
[c]Dummy variable: 0 = Greece, 1 = Japan.

To obtain a personal spending IBOP cost estimate for an overseas homeported population of N personnel, we use equation (2).

$$T = (N \times 106 + \Sigma n_i Pay_i \times .48 + N \times p_{acc} \times 196 + N \times p_{shore} \times 38$$
$$- N \times p_{housing} \times 124 - N \times p_{area} \times 7) \times f \qquad (2)$$

where T = total monthly personal spending IBOP cost for N personnel in an overseas homeport

n_i = number of personnel in the ith paygrade

Pay_i = base pay for those in the ith paygrade

p_{acc} = proportion accompanied

p_{shore} = proportion assigned to shore commands

$p_{housing}$ = proportion in Navy housing

p_{area} = 0 for the Mediterranean area
1 for the Western Pacific

f = .69 if U.S. facilities are available
1 if U.S. facilities are not available

CONUS Deployed Personnel

To estimate the marginal IBOP cost of overseas homeporting due to personal spending, we

---

[1]Analysis of the historical data revealed that an average of 69 percent (69 and 68 percent in Greece and Japan, respectively) of all expenditures by overseas homeported personnel contributed to the IBOP cost. The remaining 31 percent of their expenditures was associated with the purchase of U.S. goods and services in U.S. government sponsored facilities overseas.

must also determine the personal spending cost of deployed personnel. Estimates of personal spending by deployed personnel are based upon average expenditures on foreign economies during the course of a deployment.

No simple relationship was found between Navymen's income and their personal spending while on liberty. Therefore, regression estimates similar to those made for personnel aboard overseas homeported units were not made. An average IBOP estimate, per individual, was determined by taking the mean of the distribution of the Navymen's personal spending while on liberty. This was then divided by the number of months the ship was deployed in either the Mediterranean or Western Pacific to produce an IBOP expenditure per man month during the period of the deployment.

In fiscal year 1973, the average (mean) IBOP cost per man month was $71 for the Mediterranean and $148 for the Western Pacific. The IBOP costs due to the deployed Navymen's personal spending on the local economies in various Mediterranean and Western Pacific ports were estimated from a survey of 2992 personnel aboard 13 ships deployed to these areas. Purchases in U.S. exchanges and clubs were apportioned, based on the amounts of foreign goods sold by those facilities in a "typical" month.

Marginal Personal Spending

The marginal IBOP costs for a given homeport are then computed on an annual basis using equation (3).

$$G = T - \left\{ [N \times (1-p_s)] \times [D + (C \times P_m)] \right\} \tag{3}$$

where G = yearly marginal personal spending IBOP cost

T = total annual personal spending for N homeported personnel

N = number overseas homeported

$1-p_s$ = proportion of overseas homeported personnel assigned to sea

D = prorated average annual personal spending of CONUS deployed personnel

C = average annual family consumption of foreign goods

P_m = proportion of married personnel aboard CONUS deployed units.[1]

An estimate of C, the annual propensity to consume foreign goods for the average U.S. family, was based upon the trend suggested by projecting the "imports for consumption" divided by the number of U.S. households beyond the 1972 time period for which these data[2] were available. The trend analysis, shown in figure 1, projects the annual import rate per family at $844 for 1973, $905 for 1974, and $966 for 1975.

To summarize the procedure for estimating the annual marginal personal spending IBOP cost due to overseas homeporting in other areas where specific values of the parameters in equation (1) are available, the following steps must be followed:

(1) Determine the paygrade and base pay distribution for all personnel aboard the overseas homeported ships;

---

[1]Based upon FY 1973 data, P_m = 40 percent.
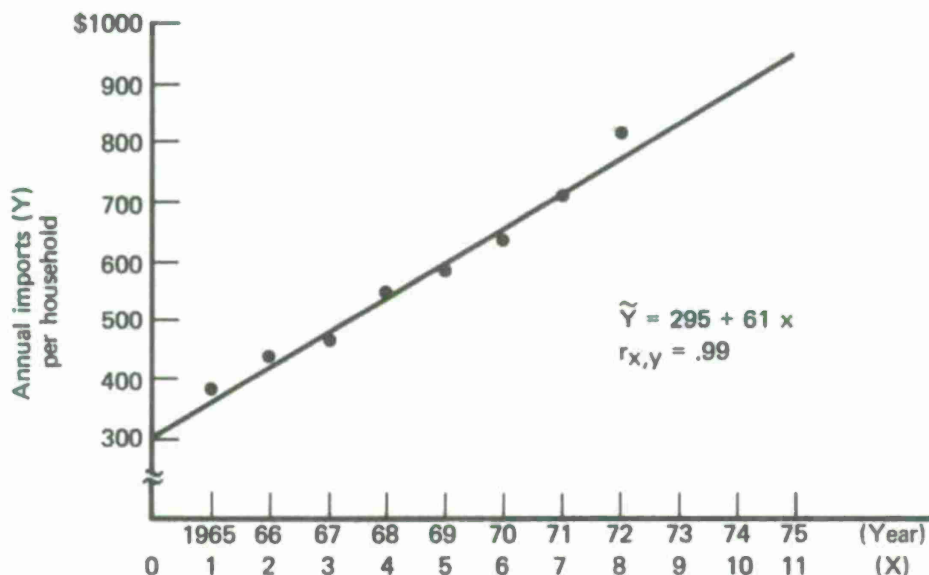[2]Source: 1973 Statistical Abstracts of the United States.

FIG. 1: ANNUAL IMPORTS OVER TIME

(2) Determine the paygrade and base pay distribution of all shore based personnel considered incremental to overseas homeporting;

(3) Compute the proportions of personnel in the 2 above items who are:
  (a) stationed ashore (p_{shore})
  (b) living in Navy housing ($p_{housing}$), and
  (c) accompanied with dependents (p_{acc})

(4) Categorize the overseas homeport as "Mediterranean" or "Western Pacific"

(5) Determine if U.S. government facilities will be available to supply goods and services to overseas homeported personnel and dependents

(6) Determine the average annual spending of CONUS deployed personnel

(7) Estimate the average annual IBOP costs of imports for families of CONUS deployed personnel.

The planning factors required in these steps could be provided by Navy planners for an overseas homeporting option. In lieu of definite information, factors observed from the relevant overseas homeporting experience can be used. The data required in steps 2, 6 and 7 is "time dependent" and should be adjusted for projection beyond FY 1973. Updated pay scale values required in step 2 may be obtained by inflating FY 1973 base pay scales shown in table 4 at an annual rate of 6 percent. Personal spending estimates for CONUS deployed personnel (step 6) for FY 1973 can be used but should be increased at an annual rate of 4.5 percent in the Mediterranean and 3.5 percent

in Western Pacific.[1] The cost of imports required in step 7 can be projected beyond the 1973 amount by $844 by increasing them at an annual rate of $61 (see figure 1).

TABLE 4

U.S. GOVERNMENT CIVILIAN AND MILITARY MONTHLY PAY[a]

Paygrade	U.S. government service	U.S. government classified[b]	U.S. Navy officer	U.S. Navy Warrant Officer	U.S. Navy enlisted
1	$ 427		$ 566	$ 741	$307
2	499		855	865	342
3	591		1036	989	390
4	687		1254	1169	445
5	781		1578		507
6	884		1902		577
7	952				667
8	1079				807
9	1167				965
10	1295				
11	1404				
12	1667				
13	1962				
14	2294				
15	2782				
16	3000				

[a]U.S. government service salaries based on 1973 pay tables for average time in grade.
[b]All "WD" employees were costed at the median pay of $1177.

The following is an application of the procedure to determine the marginal personal spending IBOP costs for a variety of overseas homeporting options using planning factors developed from the 1973 data.

Costs are estimated for various combinations of the following options: (a) area (Mediterranean or Western Pacific); (b) presence and absence of shore facilities and/or personnel; (c) presence and absence of Navy housing (for the option where the facilities are present); and (d) ship type (CVA, CLG, and DD). The paygrade distributions used in the illustration are typical of those of ships currently being overseas homeported, and are shown in table 5. The pay rates used are FY 1973 rates. Estimates for the b weights are those shown in equation (2), and the p values used for percent accompanied, percent ashore and percent in housing are observed proportions of current overseas homeported populations.

The results shown in table 6 are presented in terms of man-year costs, i.e., marginal cost of the population ÷ number in the population (N), to facilitate comparisons across ship types. Costs per ship may be obtained by multiplying the man-year values by the number of ship's personnel. Annual costs for K ships can be determined by multiplying ship-year costs by K.

---

[1]In making projections beyond the base year 1973, estimates of CONUS deployed spending was increased at the same rate as the projections for personal spending by homeported personnel. For example, the projected average monthly personal expenditure for overseas homeported personnel in the Mediterranean for 1974 was $281, which is 4.5 percent greater than the $269 average estimated for 1973. Using a similar procedure for Western Pacific, projections were inflated at the annual rate of 3.5 percent.

TABLE 5

PAYGRADE DISTRIBUTIONS[a]

Paygrade	Ship type		
	CVA	CLG	DD
E 1	0	0	20
2	264	46	49
3	1770	431	42
4	598	160	75
5	538	122	46
6	301	57	34
7	138	32	14
8	35	12	3
9	20	2	0
O 1	34	15	5
2	79	12	5
3	85	7	5
4	37	9	1
5	24	4	1
6	1	1	0
W 1	0	0	0
2	0	0	0
3	34	12	0
4	0	0	0
Total (N)	3958	940	300

[a] n_i, or number of men in each paygrade.

TABLE 6

MAN-YEAR PERSONAL SPENDING IBOP
COSTS FOR SEVERAL OSHP OPTIONS
(In dollars for 1973 pay scales)

Ship type	N	Option											
		No supporting shore personnel						With supporting shore personnel[a]					
		Mediterranean			Western Pacific[b]			Mediterranean			Western Pacific		
		f^c		$\bar{f}$	f		$\bar{f}$	f		$\bar{f}$	f		$\bar{f}$
		H^d	$\bar{H}$	$\bar{H}$	H	$\bar{H}$	$\bar{H}$	H	$\bar{H}$	$\bar{H}$	H	$\bar{H}$	$\bar{H}$
CVA + air wing	3958	1887	2112	3593	943	1169	2641	2036	2262	3757	1185	1411	2897
CLG	940	1836	2062	3520	892	1117	2566	1986	2112	5684	1134	1360	2823
DD	300	1843	2069	3530	899	1125	2577	1993	2219	3694	1141	1367	2833
Planning factors[e]		1857	2101	3576	931	1157	2624	2025	2251	3740	1174	1399	2880

[a] $P_{shore} = .1(n_i \div N$, shore $\sim n_i \div N$, sea)

[b] $P_{area} = 1$ for Mediterranean; 0 for Western Pacific

[c] $f = .69$, and $\bar{f} = 1$

[d] $P_{housing} = .22$

[e] Average of the 3 ship types.

Note: f represents availability of shore facilities; $\bar{f}$ and $\bar{H}$ are used to indicate no facilities and no housing available.

Comparing man-year costs across ship types reveals the costs to be nearly (within 1 percent) identical. This result was predictable, since the relative proportion of men in each paygrade is similar across ship types. Considerable change in the distribution of paygrades ($n_i \div N$) would have to occur before significant differences in man-year costs would result. Therefore, the man-year costs shown in the example would apply to most ship types Navy planners might consider for overseas homeporting, for the types of options illustrated.

This suggests that the "average" costs shown should be used as planning factors in estimating the marginal personal spending IBOP costs for future overseas homeporting programs. To account for the time dependent factors such as payscales, CONUS deployed costs and propensity to consume foreign goods, these factors should be inflated at an annual rate of 4 percent[1] beyond the base year of FY 1973.

When using these figures as planning estimates, it must be assumed that the p values, i.e., proportion accompanied, proportion in Navy housing, proportion assigned ashore, will be representative of future overseas homeporting programs. When different values for these proportions are determined for future programs, the procedure outlined for computing these costs under the different options should be followed to arrive at appropriate costs, in lieu of using the planning estimates.

SHIP'S MAINTENANCE

The procedure estimates marginal IBOP costs of ship's maintenance for a given ship type on a ship-year basis. It is assumed that ships to be overseas homeported in the Mediterranean and Western Pacific under future programs will use the same foreign repair and maintenance facilities as are currently being used by overseas homeported ships in these areas and to the same extent. Specifically, two assumptions are required. First, the IBOP expenditures per ship-year experienced in fiscal 1973 for both overseas homeported and CONUS deployed ships are representative of what will happen in the future; and second, the ratio of fiscal 1973 expenditures per ship-year for the overseas homeported ships to those for CONUS deployed ships (by appropriate ship type) can be applied to other ship types in future years.

The procedure for estimating marginal IBOP costs on a ship-year basis is to compute non-scheduled maintenance costs for overseas homeported ships as a function of the IBOP expenditures for similar CONUS deployed ships, and to estimate scheduled maintenance costs as a proportion of non-scheduled costs. This procedure is shown in equation (4).

$$MSM_k = CE_k \times f_{\overline{S}}^* \times (1 + f_s) \tag{4}$$

where MSM_k = the marginal IBOP cost per ship-year for maintaining an overseas homeported ship of type k;

CE_k = ship-year IBOP expenditure of non-scheduled repairs for CONUS deployed ship type k;

$f_{\overline{S}}$ = ratio of IBOP expenditures for overseas homeported ships (OE_k) to CONUS deployed ships (CE_k), i.e., OE_k/CE_k;

$f_{\overline{S}}^*$ = the ratio of marginal to CONUS deployed non-scheduled maintenance costs, i.e., $[(OE_k - CE_k)/CE_k]$, or $f_{\overline{S}} - 1$

---

[1]This inflation factor was determined by projecting the data shown in table 6 over a 3-year period and observing the changes associated with inflating payscales, CONUS deployed costs, and propensity to consume variables.

(Applying $f_{\bar{S}}^{*}$ to the values of CE_k allows the direct calculation of the marginal cost for non-scheduled maintenance);

f_S = the ratio of scheduled to marginal non-scheduled maintenance costs, i.e., $\dfrac{S}{\bar{S}}$

The planning factor $f_{\bar{S}}$ is based upon the experience of the destroyers and cruisers home-ported in Greece and Japan. The observed data from fiscal 1973 is shown in table 7.

TABLE 7

**COMPARISON OF IBOP FUNDS EXPENDED FOR
NON-SCHEDULED AVAILABILITIES IN FY 1973**
(Expenditures/ship-year in thousands of dollars)

Area	Homeport	Cruisers	Destroyers
Mediterranean	CONUS (CE_k)	46.5	7.3
	Overseas (OE_k)	260.3	42.7
Western Pacific	CONUS (CE_k)	305.1	218.4
	Overseas (OE_k)	979.5	439.1

$f_{\bar{S}}$ Mediterranean $= \dfrac{OE_k}{CE_k} \cong 5.7$; $f_{\bar{S}}$ Western Pacific $\cong 2.6$

By applying these factors of 5.7 and 2.6 to the non-scheduled repair costs for CONUS ships we can estimate these costs for ships of any given type being considered for future overseas homeporting programs.

The marginal IBOP cost for scheduled maintenance will depend upon considerations such as the policy for accomplishing overhauls in overseas facilities, rotation cycles, and material condition of the ships. In the absence of costs already budgeted for planned maintenance, which accout for these considerations, it will be necessary to estimate future costs of this kind as a function of present experience with overseas homeported ships.

The value of the planning factor f_S (ratio of scheduled maintenance costs to non-scheduled costs) was also determined from historical data.

For the DDs homeported in the Mediterranean, the planned maintenance costs per ship-year were \$42 thousand.[1] This was 1.24 times the marginal non-scheduled cost estimate of \$34 thousand.[2]

In the Pacific, the cruiser and destroyers experienced a similar situation. The scheduled portion of the maintenance cost for the homeported cruiser (\$719 thousand) was 1.47 times that of the marginal non-scheduled cost (\$488 thousand). Also, the total IBOP expenditure per ship-year for destroyers homeported in Japan was \$858 thousand and scheduled costs (\$509 thousand) were 1.46 times that of the marginal non-scheduled IBOP expenditures (\$349 thousand).

---

[1] The scheduled maintenance costs per ship-year were derived from the total planned maintenance costs of the overseas homeported ships over a three year period.

[2] Since the scheduled maintenance costs were those projected over a three year period, the values used here for the non-scheduled costs were not those observed in FY 1973, but those expected over the next few years, i.e., $CE_k \times f_{\bar{S}}^{*}$.

The values of 1.2 and 1.4 represent IBOP scheduled maintenance factors (f_s) which can be applied against marginal non-scheduled maintenance estimates to estimate the IBOP expenditures for scheduled maintenance. The costs for scheduled maintenance derived from these factors represent "rule of thumb" estimates to be used where current maintenance policies are applicable. For example, if the capability is developed in the Mediterranean of overhauling ships, the factor for that area would have to be revised.

Table 8 presents the estimates of marginal IBOP for ship's maintenance using these historical planning factors. The values of CE_k are based upon observed data for each ship type in fiscal 1973.

TABLE 8

**ESTIMATES FOR MARGINAL IBOP EXPENDITURES PER SHIP-YEAR
FOR MAINTENANCE OF OVERSEAS HOMEPORTED SHIPS IN
MEDITERRANEAN AND WESTERN PACIFIC**
(Thousands of dollars)

Ship type	CE_k	f_s^*	Non-scheduled marginal cost $(CE_k \times (f_s^*))$	f_s	Scheduled cost (non-sch $\times f_s$)	Total marginal IBOP (MSM_k)
			Mediterranean			
CL	46	4.7	221	1.2	265	486
CV						3400
DD	7	4.7	33	1.2	40	73
LKA/LP/LST	3	4.7	14	1.2	17	31
AD/AG/AS	9	4.7	42	1.2	50	92
AO/AE	22	4.7	103	1.2	123	226
AF	22[a]	4.7	103	1.2	123	226
			Western Pacific			
CL	305	1.6	488	1.4	683	1171
CV						3300
DD	218	1.6	349	1.4	489	838
LKA/LS/LST	316	1.6	506	1.4	708	1214
AD/AG/AS	58	1.6	93	1.4	130	223
AO/AE	320	1.6	512	1.4	717	1229
AF	268	1.6	429	1.4	600	1029

[a] Value of CE_k for AO/AE ship types used here.

No data breakout by scheduled/non-scheduled maintenance is provided for the aircraft carriers (CV). The amount of funds planned for selected restricted availabilities of carriers homeported overseas will be used, to a major degree, for any voyage repairs, which otherwise would be accomplished during a non-scheduled RA/TA period. Under present policy, SRA periods are scheduled for aircraft carriers for both expected voyage repair work and scheduled equipment modifications.

The requirement to keep such important ships at high state of readiness is obvious and the SRA periods are funded accordingly. This is reflected in the high total expenditure per ship-year for the carriers. While the estimate of the split between non-scheduled and scheduled maintenance of the CVs performed during the SRA could be somewhat arbitrary, the total marginal IBOP cost for overseas homeported CVs is not. The IBOP costs of $3.4 million for the Mediterranean and $3.3 million for the Western Pacific are based upon current total cost estimates of SRA periods for CVs.

BASE SUPPORT

The incremental base support costs for new overseas homeporting programs are dependent upon certain characteristics of the homeport itself, as well as the types and number of units considered for the program. The number of personnel being supported and the cost of leases will be the driving variables for the recurring costs, while the types of units and characteristics of the homeport, such as existence of support facilities and desired expansion, will affect the one-time costs.

The recurring support costs for new overseas homeporting programs are based upon the apportioned support costs per man-year observed in the historical data from Greece and Japan.

Leases and one-time support costs are largely dependent upon policy decisions regarding the need to expand facilities required by particular types of units for their operation. For example, overseas homeporting a CV/CVW requires an airfield, which may be available but in need of expansion, to handle additional aircraft. The expansion of pier space and cold iron facilities are other policy decisions which will depend upon available facilities and the number of units utilizing them.

It is difficult to extrapolate one-time support costs and lease costs from the experience in Japan and Greece because of the unique characteristics of each area and the configurations of units which could be considered for future overseas homeporting programs. One-time costs and leases will be estimated as a portion of the recurring expenditures. These estimates for one-time costs and leases may be useful for general planning purposes but should only be used when definite data for a particular homeport is not available.

Table 9 provides the pertinent information on recurring and one-time costs for Greece and Japan along with the number of men in the overseas homeporting program. The average recurring cost per man-year (RC) is $357 in the Mediterranean area (excluding lease costs in Greece) and $249 in the Western Pacific. These figures are based upon observed data in fiscal 1973 and programmed expenditures for fiscal 1974 and 1975.

TABLE 9

BASE SUPPORT DATA FOR GREECE AND JAPAN
(Millions of dollars)

	Greece			Japan		
	1973	1974	1975	1973	1974	1975
Recurring costs						
Leases	$1.6	2.4	2.6	—	—	—
Other	$ .9	1.3	1.6	.5	1.7	2.5
One-time costs	$ .5	.2	—	—	.9	.0
OSHP population (N) in man-years	1385	1847	7402	3865	7213	7883

During these years, the lease cost in Greece was 1.75 times as great as the other recurring costs and the total one-time costs were 18 percent of the recurring costs. In the Western Pacific, no leases were required and one-time costs were 19 percent of the recurring costs during the period.

-13-

The marginal base support cost (MBS) in the Mediterranean and Western Pacific can be estimated from equation (5) as a function of the man-years being supported plus lease and one-time costs, where lease and one-time costs are a proportion of the recurring costs.

$$MBS = (man\text{-}years) \cdot RC \cdot (1 + fl + fo), \tag{5}$$

where MBS = Annual marginal IBOP cost of base support for area (Mediterranean or Western Pacific)

   RC = Recurring cost per man-year in Mediterranean or Western Pacific

   fl = Factor for leases in Mediterranean or Western Pacfiic

   fo = Factor for one-time costs in Mediterranean or Western Pacific

The values of the RC, fl, and fo planning factors are shown in table 10 for the Mediterranean and Western Pacific areas.

TABLE 10

BASE SUPPORT PLANNING FACTORS

Parameter	Mediterranean	Western Pacific
RC	$357	$249
fl	1.75	——
fo	.18	.19

If it is determined that leases will be required to support an overseas homeporting program in the Western Pacific, a value of 1.75 for fl should be used.

SUMMARY OF PROCEDURE USING PLANNING FACTORS

1. Specify number of overseas homeported units (K), average number of personnel aboard each unit (N), and options for area, housing, facilities, and shore personnel. Marginal personal spending cost (MPS) is obtained by:

$$N \times K \times \text{option},$$

where option is the dollars per man-year for a given combination of options shown as planning estimates in table 6.

2. Specify the number of ships of each type. Marginal ship's maintenance cost (MSM) is obtained by:

$$K \times [CE_k \times f_{\bar{S}}^* \times (1 + f_S)],$$

where the CONUS deployed cost (CE_k) for ship type k and the planning factors $f_{\bar{S}}^*$ and f_S are determined by entering table 8.

3. Specify if leases or one-time costs will be incurred for base support. Marginal base support cost (MBS) is obtained by:

$$(N \times K/1 - p_{shore}) \times RC \times (1 + fl + fo),$$

where RC is recurring costs per man-year, 1 equals Mediterranean or Western Pacific, fl is the cost factor for leases and fo is the cost factor for one-time costs, obtained from table 10.[1]

4. The sum of the above 3 costs will be the estimate of the marginal IBOP cost of the overseas homeporting program.

Applying this procedure to estimation of the marginal IBOP cost, in FY 1973 dollars, for 6 destroyers (N = 300) and 1 CV (N = 4000) in the Western Pacific and the options (a) shore personnel (10 percent of total), (b) Navy housing, (c) facilities, (d) planned maintenance, (e) no leases and (f) one-time base support costs, results in the following:

$$\begin{aligned}
MPS &= (6 \times 300 + 1 \times 4000) \times \$1174 \\
&= 5800 \times \$1174 \\
&= \$6809K,
\end{aligned}$$

$$\begin{aligned}
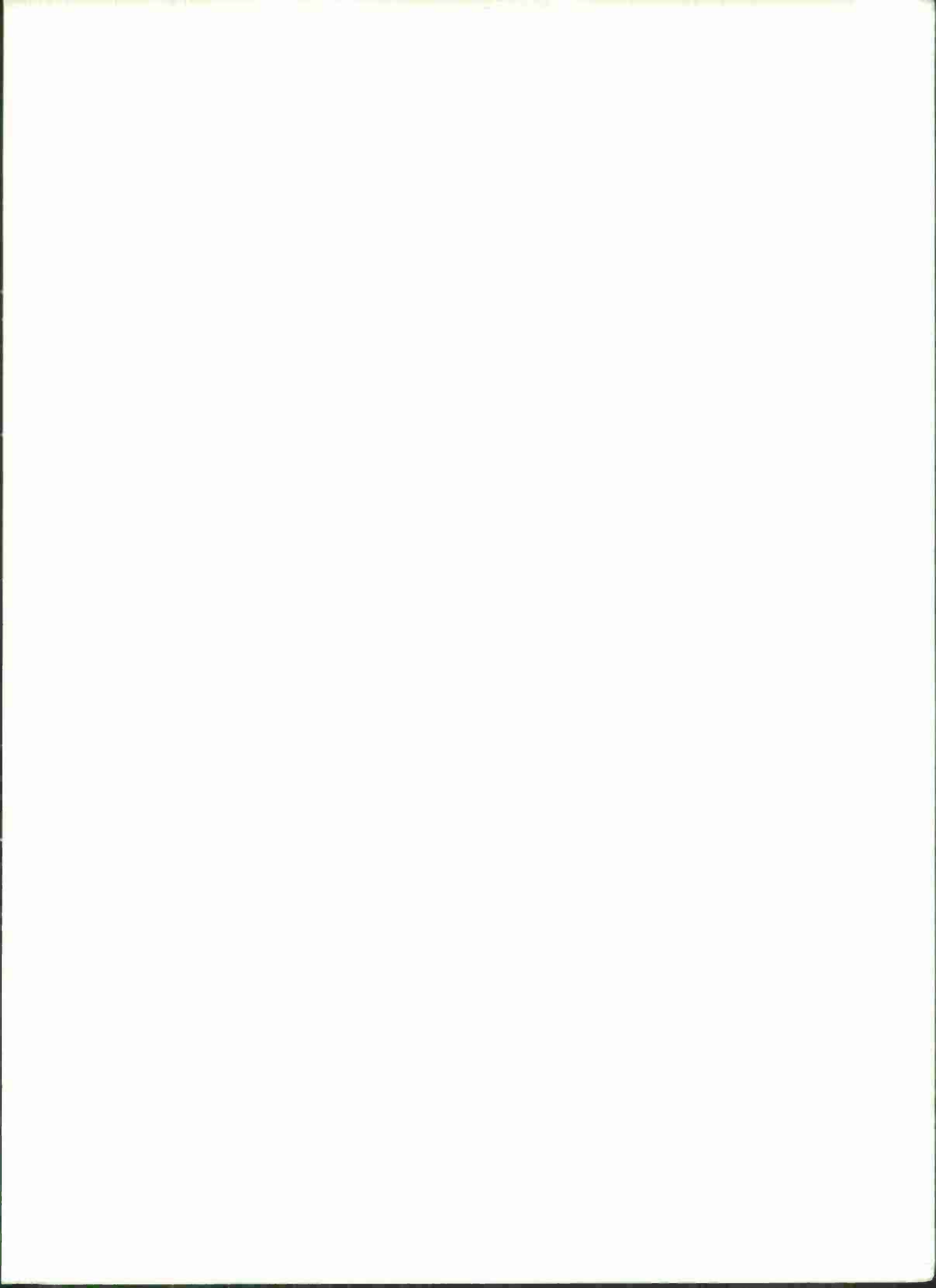MSM &= (6 \times \$838) + \$3300 \\
&= \$8328K, \text{ and}
\end{aligned}$$

$$\begin{aligned}
MBS &= 6444 \times 249 \times (1 + .19) \\
&= \$1909K;
\end{aligned}$$

total marginal IBOP cost (MPS + MSM + MBS) = $17,046K.

---

[1]Note that here shore personnel are included in the number of overseas homeported personnel.

REFERENCES

(1) Center for Naval Analyses, "Preliminary Estimates of the Marginal IBOP Costs of Navy Overseas Homeporting in Athens, Greece," (CNA)248-74, Unclassified 28 Feb 1974

(2) Center for Naval Analyses, "Estimates of the Marginal Balance of Payment Costs for Overseas Homeporting in Japan, FY 1973-75," (CNA)1723-74, Unclassified 25 Oct 1974